

CLAIMS

What is claimed is:

1. A method of modeling speech distinctions for a computer-animated talking head which models speech production articulators for a given segment of speech, said talking head having a face portion, comprising:

displaying a graphical representation of a selected voice characteristic of said speech segment at a position proximal to the face portion of said talking head.

2. A method as recited in claim 1, further comprising:
modulating the color of said graphical representation in response to a change in a selected voice characteristic of said speech segment.

3. A method as recited in claim 2, wherein said color of said graphical representation is responsive to voicing of said speech segment.

4. A method as recited in claim 1:
wherein said face portion of said talking head has a mouth portion; and
further comprising displaying said graphical representation at a position proximal to the mouth portion to appear as if it is emanating therefrom.

5. A method as recited in claim 1, further comprising:

displaying a particle-cloud image proximal to the face portion of said talking head
in response to a change in a selected voice characteristic within said speech segment.

5 6. A method as recited in claim 5, wherein said particle-cloud image is
displayed by distributing a plurality of displayed particles within a generally circular,
oval, or lenticular region.

7. A method as recited in claim 6, wherein said displayed particles comprise
small regions which are displayed in a contrasting color or shade which allow them to
be visually distinguished from background color.

8. A method as recited in claim 5, wherein said selected voice characteristic
comprises plosion, or the presence of stop consonants, within said speech.

9. A method as recited in claim 8, further comprising:
displaying a single short particle-cloud image to represent a labial stop within
said speech.

10. A method as recited in claim 8, further comprising:
displaying an elongated single particle-cloud image to represent an alveolar stop
within said speech.

16. A method as recited in claim 1, further comprising:

displaying a particle-stream graphic image proximal to the face portion of said talking head in response to a change in a selected voice characteristic of said speech segment.

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17. A method as recited in claim 16, wherein said particle-stream graphic image is displayed as being angularly dispersed from the mouth portion of said talking head.

18. A method as recited in claim 17, further comprising:

modulating, in response to changes in a selected voice characteristic of said speech segment, angular dispersion of said particle-stream graphic image;

wherein said particle-stream graphic image appears to emanate from the mouth of said talking head.

19. A method as recited in claim 18, wherein said selected characteristic of

said speech comprises the spectral spread of acoustic energy present in said speech segment.

20. A method as recited in claim 16, further comprising:

displaying said particle-stream graphic image as a plurality of small regions in a contrasting color or shade which allows them to be visually distinguished from the

background surrounding said talking head.

21. A method as recited in claim 20, further comprising:

varying the level of contrast between the particles within said particle-stream

5 graphic image in response to a change in a selected voice characteristic of said speech segment.

22. A method as recited in claim 21, wherein said selected voice characteristic

comprises the intensity of fricative energy present in said speech segment.

23. A method as recited in claim 16, further comprising:

displaying said particle-stream graphic image with the appearance of outward
movement from the mouth portion of said talking head.

24. A method as recited in claim 16, wherein said selected voice characteristic

comprises the presence of fricatives in said speech segment.

25. A method as recited in claim 16, further comprising:

displaying said particle-stream graphic image with vertical striations in response

20 to a change in a selected voice characteristic of said speech segment.

26. A method as recited in claim 25, wherein said selected voice characteristic of said speech segment comprises vocal cord vibration.

27. A method as recited in claim 1, further comprising:

5 displaying a small graphic as a slidable element on a vertical bar whose relative position on said bar is responsive to said selected voice characteristic of said speech segment.

28. A method as recited in claim 29, wherein said selected voice characteristic comprises the pitch of said speech segment.

29. A method as recited in claim 1:

wherein said talking head has a throat portion; and

further comprising displaying concentric outline images proximal to the throat portion of said talking head in response to a change in a selected voice characteristic of said speech segment.

30. A method as recited in claim 29, wherein said voice characteristic comprises throat vibration associated with a portion of said speech segment being modeled.

31. A method as recited in claim 29, wherein said concentric outline images comprise concentric substantially circular images.

32. A method as recited in claim 1:

wherein said talking head has a nose portion; and

further comprising displaying concentric outline images proximal to the nose of portion of said talking head in response to a change in a selected voice characteristic of said speech segment.

33. A method as recited in claim 32, wherein said voice characteristic comprises nasality.

34. A method as recited in claim 32, wherein said concentric outline images comprise concentric substantially triangular images.

35. A method of modeling speech production articulators within a computer-animated talking head for a given segment of said speech segment, comprising:

modulating the appearance of the surface of said talking head in response to a selected voice characteristic of said speech segment.

36. A method as recited in claim 35, further comprising:

modulating surface coloration on a portion of said talking head in response to a change within a selected voice characteristic of said speech segment.

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37. A method as recited in claim 36:

wherein said talking head has a nose portion; and

further comprising colorizing at least a portion of said nose portion of said talking head in response to a selected voice characteristic of said speech segment.

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38. A method of displaying speech production articulators on a computer-
animated talking head, comprising:

modulating a facial or articulatory feature of said talking head in response to a selected voice characteristic within a given segment of speech.

39. A method as recited in claim 38:

wherein said talking head has a nose portion; and

further comprising modulating the width of said nose portion said talking head in response to changes within a selected voice characteristic of said speech segment.

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40. A method as recited in claim 39, wherein said selected voice characteristic comprises nasality.

41. A method as recited in claim 38, further comprising:

modulating the position of said nose portion of said talking head in response to a change within a selected voice characteristic of said speech segment.

5 42. A method as recited in claim 41, wherein said modulation simulates a form of twitching.

43. A method as recited in claim 38:

wherein said talking head has a throat portion; and

10 further comprising modulating the position of at least a portion of the throat portion of said talking head in response to a change within a selected voice characteristic of said speech segment.

15 44. A method as recited in claim 43, wherein said selected voice characteristic comprises vocal cord vibration.

45. A method as recited in claim 38:

wherein said talking head has an eyebrow portion; and

20 further comprising modulating the position of said eyebrow portion in response to changes within a selected voice characteristic of said speech segment.

46. A method as recited in claim 45, wherein said selected voice characteristic of speech comprises voice pitch.

47. A method as recited in claim 38:

5 wherein said talking head has a tongue portion; and
further comprising increasing the visibility of said tongue portion to enhance modeling of speech production articulators.

48. A method as recited in claim 47, further comprising:
displaying a cutaway half-face view of said talking head;
wherein an outline and position of said tongue portion is visible.

49. A method as recited in claim 48, further comprising:
displaying said half-face view wherein an outline and position of said tongue, and
a palate and teeth are visible.

50. A method as recited in claim 49, further comprising:
displaying the position of the palate and teeth in relation to said tongue.

20 51. A method as recited in claim 49, further comprising:
highlighting an area of contact between the tongue and the palate and teeth by a change in color.

52. A method of reshaping the canonical face of a computer-animated talking head to match a target facial model within a morphed talking head model, comprising:
registering a target facial model to which said talking head is to be matched;
5 marking facial landmarks associated with a polygon frame of said talking head onto said registered target facial model; and
warping said canonical face to that of said target facial model;
wherein said warping shifts the landmarks of said canonical talking head to the corresponding landmarks within said registered target facial model.

53. A method as recited in claim 52:
wherein said facial target model has ears, eyes, and lips; and
further comprising separately rendering said ears, eyes and lips when matching
said canonical face to said target facial model.

54. A method as recited in claim 52, wherein said target model is selected from the group of target models consisting essentially of convex-shaped models and star-shaped models.

55. A method as recited in claim 54, further comprising:
representing non-convex portions of said target model on said morphed talking head model with polygon-shaped patches.

56. A method of reshaping the canonical face of a computer-animated talking head to match a target facial model, comprising:

translating vertices of a polygon frame until the center point of said target facial

5 model substantially coincides with a coordinate system origin;

moving said vertices a unit distance from said origin;

calculating a weighted influence of a landmark on said target face into new vertex positions;

determining the face of a projected target facial model to which a given vertex projects to provide a homeomorphic mapping between said target face and the canonical face of the original polygon frame model; and

mapping morph coordinates of each canonical face vertex as a barycentric coordinate of the target facial model which guides the final morphing of the canonical face to said target facial model.

57. A method as recited in claim 56, wherein said canonical facial model and said target facial model to which it is being warped are not within the same coordinate space.

58. A method of adjusting a computer-animated talking head to match a particular face, comprising:

displaying a polygon grid representing a frame upon which the talking head is

generated;

overlaying the polygon grid onto an image of said face which is to be used for
said talking head;

selecting and moving control points within said polygon grid to match locations
5 on said face; and

generating a talking head model from said face image.

59. A method as recited in claim 58, further comprising:

articulating said face image in response to movement within said talking head.

60. A method as recited in claim 58, wherein said control points can be found
at intersecting nodes of said polygon grid.

61. A method as recited in claim 60, further comprising:

highlighting said intersecting nodes to indicate a selection area associated with
said control points.

62. A method as recited in claim 61, further comprising:

applying different forms of highlighting to said intersecting nodes to represent
selected and non-selected control points.

63. A method as recited in claim 62, wherein said highlighting comprises the
use of different colors.

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64. A method as recited in claim 58, further comprising:

displaying a talking head image with a matching overlaid polygon frame as a reference for the placement of control points.

5 65. A method as recited in claim 58, further comprising:

displaying a resultant talking head image based on the positioning of said control points over said image.

66. A method as recited in claim 58, further comprising:

warping the facial structure of said particular face.

67. A method as recited in claim 58, wherein warping is selected and control points of said polygon frame are dragged to new positions to alter facial characteristics of the talking head generated from said face image.

68. A method as recited in claim 58, wherein said polygon grid comprises a triangular grid.

69. A method as recited in claim 58, further comprising:

controlling the parameters utilized for modeling a three dimensional face from the polygon grid.

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70. A method as recited in claim 69, further comprising:
controlling texture for modeling the three dimensional face.

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